

# On various protocols for direct loading of implant-supported fixed prostheses

Akademisk avhandling

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Av

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## **This thesis is based on the following papers:**

**I.** Östman PO, Hellman M, Nilson H, Ericsson I. Provisional implants: a clinical prospective study in 45 patients, from implant placement to delivery of the final bridge. *Clin Implant Dent Relat Res.* 2004;6:142-9.

**II.** Östman PO, Hellman M, Wendelhag I, Sennerby L. Resonance frequency analysis measurements of implants at placement surgery. *Int J Prosthodont.* 2006;19:77-83.

**III.** Östman PO, Hellman M, Sennerby L. Immediate Occlusal Loading of Implants in the Partially Edentate Mandible: A Prospective 1-year Radiographic and 4-Year Clinical Study. *Int J Oral Maxillofac Implants.* *In press*

**IV.** Östman PO, Hellman M, Sennerby L. Direct implant loading in the edentulous maxilla using a bone density-adapted surgical protocol and primary implant stability criteria for inclusion. *Clin Implant Dent Relat Res.* 2005;7 Suppl 1:S60-9.

**V.** Östman P-O, Hellman M, Albrektsson T, Sennerby L. Direct loading of Nobel Directs and Nobel Perfects one-piece implants: a 1-year prospective clinical and radiographic study. *Clin Oral Impl Res* 2007; 18: 409–41.

## ABSTRACT

**Background:** Prosthetic rehabilitation of the edentulous patient with implant-supported bridges is today a routine and predictable treatment modality. The original protocol prescribed a healing period of 3 to 6 months prior to loading which means that the total treatment time can be extensive and that the patients often need to wear removable provisional prostheses during healing and treatment. The use of immediate implant loading protocols would significantly reduce treatment time.

**Aims:** The aim of this thesis was to clinically and radiographically evaluate different protocols for immediate loading of dental implants with regard to implant survival and marginal bone resorption.

**Material & Methods:** *Paper I.* The use of provisional implants (PIs) for support of a fixed temporary bridge during the healing of permanent implants was evaluated in 45 patients with either partially (19 patients) or totally (26 patients) edentulous maxillae. The patients were followed from implant surgery to abutment connection of the permanent implants. *Paper II.* The primary implant stability of 905 implants in 267 consecutive patients treated with implant-supported fixed prostheses was assessed using resonance frequency analysis (RFA) measurements (implants stability quotations, ISQ) at implant placement surgery. The results were correlated with parameters related to the patient, implant site and the implant components. *Paper III.* A total of 96 patients were evaluated for immediate loading of implant-supported bridges in the posterior mandible (insertion torque > 30 Ncm, ISQ > 60). 77 patients (85%) met with the criteria and a total of 257 implants were placed, 77 with a turned and minimally rough surface and 180 with an oxidized and moderately rough surface. A total of 111 FPDs were made. The bridges were supported by one implant and tooth or were freestanding constructions supported by 2, 3 or 4 implants. The patients were followed for at least one year with clinical and radiographic examinations. *Paper IV.* Twenty (20) patients treated with immediately loaded implant-supported bridges in the edentulous maxilla participated in the study group. Inclusion criteria for immediate loading were a minimum insertion torque of 30 Ncm and an implant stability value of 60 ISQ for the two posterior fixtures and a total sum of 200 (mean ISQ 50) for the four anterior fixtures was required. A group of 20 patients previously treated with implant-supported bridges in the maxilla by the same team following a two-stage protocol was used as a reference group. The patients were followed for one year with clinical and radiographic examinations. *Paper V.* A total of 115 one-piece implants (OPIs) with a moderately rough surface all the way up through the mucosa, were placed in 48 patients for immediate loading of single crowns and partial bridges in the mandible and the maxilla. A group of 97 patients previously treated by the same team under identical conditions with 380 two-piece implants (TPIs) for immediate loading was used as a control group. The patients were followed for one year with clinical and radiographic examinations.

**Results:** *Paper I.* Seven (3.6%) PIs failed owing to infection or pain during the observation period and were removed. Seventeen (9%) of 192 provisional implants showed mobility at the second-stage surgery, although they had served as support for the provisional bridge without clinical symptoms during the follow-up time. Five (2.2%) of the 230 permanent implants placed did not integrate and were subsequently removed at the second-stage surgery. *Paper II.* The mean primary stability for the 905 implants was 67.4 ISQ (SD 8.6) where 582 (64.3 %) showed an ISQ value of 65 or higher and 761 (84.1%) implants an ISQ value of 60 or higher. Male patients showed higher ISQ values than females, mandibular implants were more stable than maxillary ones. Implants placed in posterior regions were more stable than in anterior sites, wide platform implants were more stable than regular/narrow platform ones. There was a correlation between bone quality and primary stability, with lower ISQ values with softer bone. A lower stability was seen with increased implant length. *Paper III.* A total of four (1.6 %) of the 257 implants placed did not integrate and were subsequently removed. The overall cumulative survival rate was 98.4 % after 1 year follow-up, 96.1% and 99.4 % for turned and oxidized implants, respectively. The average bone loss was 0.7 (S.D. 0.8) mm after one year of follow-up. *Paper IV.* One (0.8%) of 123 immediately loaded implants placed did not integrate. In the control group, no implants were lost. The overall cumulative survival rates after 1 year were 99.2% for the study group and 100% for the reference group. The mean change of marginal bone level was 0.78 mm (SD 0.90 mm) for immediately loaded implants and 0.91 mm (SD 1.04 mm) for reference group implants. The differences were not significantly different. *Paper V.* Six OPIs (5.2%) were removed during the follow-up period because of extensive bone resorption and subsequent soft tissue problems. After 1 year, the mean marginal bone loss was 2.1mm (SD 1.3) for OPIs and 0.8mm (SD 1) for TPIs. 20% of OPIs showed more than 3mm of bone loss compared with 0.6% for TPIs. When compensating for vertical placement depth, OPIs still showed a lower marginal bone level and thus more exposed threads than TPIs. Depending on the criteria used, the success rate for OPIs was 46.1% or 72.2% compared with 85% or 91.6% for TPIs.

**Conclusion:** It is concluded that immediate loading of two-piece dental implants results in good clinical outcomes if high primary stability is achieved and a rigid splinting with well controlled occlusion is applied. Provisional implants can be used as support of a provisional bridge during submerged healing of permanent two-piece implants. Moreover, it is concluded that one-piece implants show more bone resorption and higher failure rates than two-piece implants after one year in function.

**Keywords:** dental implants, immediate loading, clinical studies, radiography, implant stability, resonance frequency analysis.

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